

*Adhesive Plaster in maintaining Counter-extension in the Treatment of Oblique Fractures of the Lower Extremity.*—Dr. GILBERT read the following paper on the use of adhesive plaster in maintaining counter-extension in the treatment of oblique fractures of the thigh and of the leg:—

From the time of Hippocrates to the present these fractures have occupied the mind of the profession to a greater extent perhaps than any other; yet surgeons of the largest experience, who occupy the most prominent positions in the profession, have told us, and even now tell us, that a large majority of the cases of fracture of the femur result in shortening and permanent lameness. John Bell said: "The machine is not yet invented by which a fractured thigh can be perfectly recovered." Benj. Bell said: "An effectual method of securing oblique fractures of the thigh-bone is perhaps one of the greatest desiderata in modern surgery." Ferguson says: "The fractured thigh is almost invariably shorter than its fellow." Chelius says: "Fractures of the thigh are always difficult of cure. There is most commonly deformity and shortening of the limb." With these views his learned British and American editors fully agree. Malgaigne says, in the work recently translated by Dr. J. H. Packard of this city: "When the two ends cannot be made to oppose one another to counteract the muscular contractions, it is impossible to preserve the normal length of the limb, whatever may be the apparatus or method employed." Again: "When the fragments remain in contact, or when we can replace them and keep them so by means of their serrations, it is easy to cure a fracture of the femur without shortening; in the absence of these two conditions the thing is simply impossible." Dr. V. Mott, of New York, testified, in a trial for malpractice, a few years ago, that "more or less shortening of the limb is uniformly the result after fractured thigh, even under the most favourable circumstances;" and Drs. Parker, Post, Cheeseman, and others, sustained the same view in their testimony. Dr. F. H. Hamilton, of Buffalo, N. Y., after furnishing the most interesting and reliable statistics of the results of the treatment of this fracture on record, says: "I declare, in the most positive manner, that I have never obtained like results [such as claimed by those who profess to have made perfect cures] either in the use of my own apparatus or with that of others." To this almost any amount of corroborative testimony might be added.

A full history of all the contrivances invented and used in the mechanical treatment of this fracture, if written, would constitute a large volume, every page of which would impress the mind of the reader with the fact that the treatment of this lesion is surrounded by difficulties of the gravest character.

The retentive apparatus of the ancients consisted of bandages of cerecloth and some rude attempts in the use of splints and fracture-boxes, in the straight position, depending entirely upon lateral pressure for the maintenance of the fragments in apposition. Percival Pott, who wrote after the middle of the eighteenth century, was the first to recommend the bent

posture of the fractured limb. His object was to relax the muscles, and thus obviate their mischievous effects in causing shortening. He laid the limb in carved angular splints, and placed the patient upon his injured side, resting the sound limb upon the fractured one. Dupuytren, Astley Cooper, Chas. Bell, and others, improved upon this by introducing the double inclined plane, and placing the patient upon his back, thus using the body to keep up counter-extension by its weight. Desault had previously adopted the straight method, adding a long outside splint, with extending and counter-extending bandages. These two general methods, viz., the angular and the straight, have been varied in every conceivable manner by practitioners of all countries, each projector of a new plan supposing that a great improvement had been achieved, only, however, to be superseded by the modification of some other surgeon. At present it is conceded pretty generally, that, in the greatest number of cases, the extended plan, using an outside splint long enough to reach up nearly to the axilla, meets all the indications most satisfactorily. As in most of our surgical procedures, the simplicity and constant availability of this plan constitute the measure of its value. The common apparatus is composed of a long splint, having a block projecting inwards six or eight inches below the sole of the foot; extending and counter-extending bandages; cotton batting, or junk bags, and common roller. Short splints may or may not be used. In the use of this all the muscles are equally relaxed, and their contractions are controlled more effectually by the extending and counter-extending forces employed than by any other method in ordinary use. Although all the indications *seem* to be met by this simple apparatus, yet statistics abundantly prove that many failures occur in practice. This failure of complete success by the straight method has long been attributed by surgical writers to a want of coincidence between the line of counter-extension and the axis of the limb and body. To remedy this, various modifications in the application of the counter-extending power have been proposed, and alterations made, in the several forms of apparatus. Dr. Physick improved upon the plan of Desault by extending the outside splint to the axilla, which, as will appear presently, was a real improvement. Van Houte attached a bar of wood, which projected at right angles from the upper end of the splint, and extended to the middle of the lower part of the abdomen. To this the counter-extending bandage was fastened so as to make traction in a line coinciding directly with the axis of the body. Volpe added an inner splint, and joined this to the inner extremity of the cross-piece, as a further improvement. Others, since then, have been influenced by the same idea in constructing their apparatus, some of whom about the upper extremity of a long inside splint against the tuber ischii.

It ought to be borne in mind, however, that in a well-formed lower extremity the inner condyles of the thigh-bones come together at the knees; whilst the trochanters, by the interposition of the pelvis and the necks and

heads of the thigh-bones, are about twelve inches asunder. The shafts of the tibiæ are usually parallel with each other, and their axes, when extended upwards, coincide very nearly with the axis of the trunk. The axis of the femur, however, which diverges from the knee upwards and outwards, forms an angle with the general line of the axis of the leg and body. The application of the counter-extending power, therefore, to coincide with the axis of the femur, should be made from the perineum upwards and outwards, and not in a line directly upwards. It is very evident, then, that Dr. Physick's modification of Desault's apparatus disposes of the extending and counter-extending forces in a manner which insures their coincidence with the axes of the thigh and leg more accurately than any other plan yet proposed, and is decidedly the most useful so long as loose or unadherent bandages are used for counter-extension. The extending power exerted directly downwards, coinciding with the axis of the leg, and the counter-extending power upwards and outwards, coinciding with the axis of the femur, as nearly as may be, will exert their influence in controlling the muscular contractions more effectually, and in retaining the fragments in apposition more accurately, than if the two forces acted in a line with the axis of the trunk. The salient angle formed by the axes of the femur and tibia, where they meet at the knee, is concealed by the arrangement of the muscular mass placed at the upper and inner part of the femur. The inequalities of the external contour of the limb are filled up by the wadding, or junk bags, so that the splint supports the whole extremity firmly, although extension and counter-extension are not in the same line with each other.

Why, it may then be asked, are there so many imperfect cures, even by the use of this most approved method in the hands of the most skilful? Why are limbs shorter, and patients lame for life, when we possess an apparatus which appears to meet so fully and clearly every indication as a means of retention after reduction and coaptation of the broken bone? These questions may be answered more satisfactorily after we consider briefly some of the anatomical elements which are involved in this lesion.

The femur is the largest bone of the skeleton. It is simple in its outline, and well defined in all its parts. It constitutes the upper half of the column upon which the body reposes, and, at the same time, is one of the chief agents through which all the movements of the body are performed. These diverse functions of absolute rest and free motion are provided for by the form and position of the bone. The gentle forward arching of the shaft, the neck and head diverging from this at nearly a right angle, and the salient inclination of the entire bone downwards and inwards from the sides of the pelvis, admirably fit it for the extensive and varied movements which it is destined to perform; whilst its strong cylindrical body, terminating at each extremity in large processes, forming its base and capital, fits it equally well to perform the office of a column for the support of the

trunk. The muscles appropriated to the thigh-bones are remarkable for their number, size, diverse traction, and far-reaching attachments, upwards above the pelvis, and downwards to the foot. When we consider the fact that these, in their aggregate, comprise nearly, if not fully, one-half of the muscular mass of the entire system, the magnitude of their power in steady-ing and moving the bone becomes very apparent. Between the bone and these muscles, during their integrity, there is the most accurate adaptation of function, and the most perfect harmony of action.

When, however, fracture in any part of the continuity of the former, takes place, all this beautiful symmetry of form and reciprocity of action is destroyed. The contractions of this most voluminous and energetic of all the muscular combinations in the system are powerfully and continually exerted in effecting derangement of the fragments, and disturbing their quiet apposition. In view of these anatomical and physiological facts, we ought not to be surprised, then, that the experience of all the world forces upon us the conviction that these powerful muscular contractions are not sufficiently controlled, to make cures without shortening, by the provision of any apparatus hitherto in use for counter-extension. I admit that all desirable and necessary power is at our command through the use of any of the most approved modifications of apparatus on the extended plan; but its tension cannot be endured by the patient long enough, at the seat of counter-extension, to secure union without deformity. When well adjusted, the limb is restored to its normal length, and the patient feels quite comfortable for a time. To the eye of the observer every indication appears to be fully met; but the loose counter-extending bandage, or the crutch-head of the inner splint, no matter how wide a surface they were made to occupy when first applied, will narrow down under the powerful contractions of the muscles, the pressure will become intensely concentrated over the bony points of the pelvis underlying the line of their application, and insupportable pain will be the consequence. In a large proportion of cases, in which the patient resolves to indure the pain, abrasion, excoriation, and even sloughing, will be produced by these counter-extending means, no matter how soft the cushion or unirritating the materials of which they are composed. It is a well-authenticated fact that Gen. Lafayette owed his lameness to excoriation and deep-seated ulceration produced in his perineum and groin by the counter-extending means used in the treatment of his fracture. He doubtless obeyed the orders of his surgeon not to disturb the apparatus, and endured his sufferings like a soldier, regardless of consequences. There are very few patients, however, so obedient. Malgaigne prefers the apparatus of Boyer; yet, in his opinion, in oblique fractures even this "cannot restore the limb to its normal length," in proof of which he cites a case in which "extension was kept up steadily until the forty-eighth day, when it had to be abandoned on account of the *deep ulcerations about the ankle and groin*." He explains by asserting that the power used to counteract mus-

cular action "causes pressure or constriction in proportion to the resisting force of the muscles," which, he says, "rarely fails to cause acute pain, excoriations, blisters, or even sloughs." Hence the infinite variety in the form and composition of the perineal band; in the fashioning of the upper extremity of the inner splint, by which counter-extension is made against the perineum; in the method of treating by the flexed position, with or without weights and cords passing over pulleys; and, finally, in the application of dextrine or starch; all with the same intention of saving the perineum and groin from the effects of pressure and friction. It would require more space than can well be appropriated in this communication to describe the numerous plans proposed for the defence of the perineum. To defend this part has been a principal desideratum with surgeons, and has, more than any other consideration, led to the endless modification of apparatus in the treatment of this fracture. Ordinarily, it is found, at the first visit after any of the forms of retentive apparatus in use has been adjusted, that the patient or his friends have slackened the counter-extending means, or are anxiously waiting for the surgeon to do it. In most of the cases this has to be done, and the seats of pressure and friction bathed with spirits, and soft materials interposed, so as, if possible, to relieve the pain and prevent abrasion. The same round of efforts, to abate suffering and ward off injury, must be repeated from time to time; in the meanwhile there is no constantly acting force sufficiently powerful to overcome muscular contraction, and, finally, union of overlapping bones takes place. To restrain patients in their efforts to loosen the counter-extending means, various plans have been proposed. Amongst the most recent, Dr. John Neill proposes the union of the extending and counter-extending bands outside of the long splint, partly for this purpose; and Dr. J. F. Flagg, of Boston, suggests that a padlock be put on the buckle of the counter-extending band whenever the patient persists in undoing it.

After encountering difficulties of this character during a practice of eighteen years, in the treatment of fractures of the thigh, the very favourable impression made upon my mind by the use of adhesive plaster in keeping up *extension* without pain, led me to a determination to use it for *counter-extension* as soon as an opportunity offered. This presented itself very soon afterwards in a case of so complicated a character as to afford a very fair test of the value of the plan. *This first case in which adhesive plaster was used as a means of counter-extension*, may be found recorded in the January number of the *American Journal of the Medical Sciences* for 1851. Since then I have used it in every case of fracture, not only of the thigh but of the *leg*, for counter-extension, as well as extension, with the happiest results. In the January number of the same journal for 1858 a number of cases of fracture of both thigh and leg, selected from my general practice, will be found published; in all of which it is shown most conclusively that any amount of force necessary to overcome muscular con-

traction, may be used without causing pain or excoriation at the seats of its application. This may be explained in the following manner: The adhesive plaster counter-extending bands become firmly adherent to a large extent of integument, consequently there can be no friction upon its surface; and through this extensive union with the skin, *pressure is widely and evenly diffused*. In the use of any of the ordinary unattached counter-extending means, the extent of surface occupied at the seat of pressure does not exceed eight square inches; a fractional part only of which sustains its greatest intensity, viz: that which overlies the tuber ischii, the edge of its ascending ramus, and a narrow space of the body of the pubis. The extent of surface to which the adhesive plaster counter-extending bands are attached, on the other hand, amounts to about one hundred square inches, over all of which the tension and pressure are equally distributed. In the use of the former, all the tissues lying upon the points of bone mentioned endure constant pressure, amounting often to constriction; in the use of the latter, through the elasticity of the skin, and the extensive distribution of the tractive power, pressure is slight and painless. In the use of the former, friction is produced continually by the movements of the body or limb; in the use of the latter, friction is impossible. The former glides over the surface, and acts as a ligature; the latter being adherent, cannot act thus. The former does not fix the pelvis; the latter holds it firmly, and keeps all the parts steady from the chest to the foot. The former requires the daily attention of the surgeon, to relieve suffering and prevent abrasion; the latter requires no such attention, unless the bands lose their attachment, which ordinarily does not occur more than once during the whole period of treatment. In short, by the adhesive counter-extending bands pressure is completely neutralized, friction cannot occur so long as they remain adherent, perfect quietude of the fragments is maintained; the union, consequently, requires less time, and less attention from the surgeon, and the patient is entirely free from the annoyance and suffering inseparable from the ordinary methods, no matter how great the power used to overcome the muscular contractions, or how protracted the period required for union in complicated cases.

Adhesive plaster has been used for years as a means of keeping up *extension*. Dr. F. H. Hamilton, in his report to the American Medical Association, *vide Transactions* for 1857, says: "The adhesive plaster bands are beyond all comparison the best means of making permanent extension which are at present known to surgeons. Hitherto one of the most serious difficulties in the way of extension, and the objection which has been most effectively urged against its adoption, has been the excoriations, ulcerations, and even sloughing, which so often occurred from the use of the various extending bands about the ankle. This, together with the injuries occasionally inflicted by the *perineal band*, has been regarded as a sufficient reason for preferring the flexed position. But no one who

has employed the adhesive plaster extending bands will doubt that so far as injuries to the foot and ankle are concerned, this objection is entirely disposed of." Again, he says: "I regard this simple invention, therefore, as one of the most important improvements in the treatment of fractures of the thigh."

An experience of eleven years, by this method, in the treatment of fractures of the thigh and leg, warrants me in asserting most positively that adhesive plaster as a means of making and keeping up *counter-extension*, is no less valuable, than it is here regarded by Dr. Hamilton, as a means of making and keeping up *extension*. The same difficulties arising from pressure and friction, viz., "excoriation, ulceration, and even sloughing" of the perineum and groin, are encountered when any of the unattached means are used, and are as certainly prevented when adhesive plaster is applied instead. The cases already alluded to, published in the January numbers of the *American Journal of the Medical Sciences* for 1851 and 1858, are a part of this experience, and fully sustain all that is here assumed.

In these cases it is shown that the most seriously complicated, compound, and comminuted single and double fractures in adults, children, and infants were treated without pain at the seat of counter-extension; and that the cures were perfected in unusually short periods of time. In some of the cases, adhesive plaster bands were used instead of the common roller and many-tailed bandage, with great advantage. Although the anterior and posterior counter-extending bands are usually quite sufficient, yet any additional amount of adhesive plaster may be applied in order to diffuse the tractive force still more widely. The pelvis may be fixed by girdling it with a broad horizontal band, from which any desirable amount of counter-extending power may be commanded, by strips extending from it anteriorly and posteriorly to the upper extremity of the splint. Thus the perineum, if any injury there should render it necessary, may be left free and unencumbered. Since the publication of these cases the plan has been adopted by several private practitioners, who have informed me that their success has been equally gratifying. Amongst these, Dr. Kerr, of York, Pa., recently treated a case of severely comminuted compound fracture of the thigh with the happiest results. It has also been used at the Episcopal Hospital of this city in several cases, by Dr. Kenderdine, one of the surgeons of that institution, who informed me that the results have been so favourable that hereafter the plan will be preferred by him to every other. Dr. Hunt, one of the surgeons of the same institution, informs me that he has a case now under treatment, in which adhesive plaster is being used for counter-extension.<sup>1</sup>

<sup>1</sup> *March 1st.* Dr. Hunt says: "This case has now been under treatment for six weeks. It has progressed favourably, in every respect. The patient has experienced no pain from pressure, abrasion or excoriation, at the seats of extension

As additional confirmation of the value of the practice the following cases, also of unusual character, are submitted:—

1. I was sent for, January 21, 1858, to take charge of Mrs. J. Van Gunton, aged sixty-six years, residing at No. 1206 Alder Street above Girard Avenue, who, it was stated, had fallen from the flat roof of a one story back building, and fractured her left thigh bone. When I arrived at the residence of the patient, I was informed by her son, Mr. F. Van Gunton, that the accident had occurred *seven weeks previously*, and that an “eclectic doctor” had had charge of the case and treated her from the time of the receipt of the injury to the present time. As retentive means the “doctor” had used two long narrow splints, the outer one extending from the trochanter, and the inner from the perineum, to the foot. These were bound to the limb, after supposed reduction of the fracture, by a roller. No other effort was made to keep up extension and counter-extension except with this lateral pressure. On the day when I was sent for he had removed this retentive apparatus, and informed the patient and her friends that union had taken place. It soon became evident, however, not only that union had not resulted, but that *the thigh was fractured in two places*. For these mistakes in diagnosis and treatment he was discharged. On examination, I found an oblique fracture at the union of the upper with the middle third of the femur, and another in the lower third, immediately above the condyles. From the increased breadth of the bone at the condyles, and the existing inflammation in the knee-joint, I had no doubt of the existence of vertical fracture between the condyles; but this could not then be certainly detected. The whole limb was swollen and shortened. After making as much traction with the hands, assisted by her son, as the patient could then endure, the leg was still three and a half inches shorter than the sound one. I learned that the patient, previous to the accident, had enjoyed uninterrupted good health for years; in consequence, however, of the protracted confinement, and her sufferings from inflammation and fever, she had become greatly reduced. I applied the retentive apparatus described in the publication of my first case, using adhesive plaster for extension and counter-extension. In this case, however, which required an increased amount of power to overcome the permanent shortening as well as the active contractions of the muscles, I used double adhesive bands, which were fused together by passing them over a heated surface. I also added a horizontal strip which encircled more than half of the pelvis, immediately below the crista ili, for the purpose of more securely binding the

and counter-extension, at any time. The adhesive strips used for counter-extension have been renewed but once since their first application. This became necessary, in consequence of the want of firmness of the plaster cloth; it would, therefore, be better if this consisted of linen, or some other unyielding material.” The fusion of two layers of plaster, as used in the case of Mrs. Van Gunton and others, remedies this defect almost entirely.—D. G.



counter-extending bands to the surface, and increasing the extent of attachment of the counter-extending means. That the manner of applying the adhesive bands may be fully understood, I here furnish a drawing of the apparatus. This conveys a more accurate idea of the plan than mere description. The wadding, the roller for the leg, and the many-tailed bandage for the thigh, are omitted.

Fig. 3.



1. Anterior and posterior counter-extending adhesive bands, two and a half inches wide, crossing each other before they pass through the mortise holes. 2. The same, crossing at the upper part of thigh and perineum. 3. Horizontal pelvic band, which may be three inches wide. 4. Extending bands, receiving strap of tourniquet in the hollow of the foot. 5. Tourniquet.

Having adjusted the apparatus, extension and counter-extension were made by the *tourniquet*, and were increased from day to day until the fractured limb was brought very nearly to the length of the sound one. The tension necessary to overcome the shortening and muscular resistance was, from the peculiar nature of this case, unusually great, *yet no pain was complained of at the seats of extension or counter-extension*. One of the peculiar advantages of the use of adhesive plaster for these purposes is that the extent of its attachment may be increased, if necessary, until the whole pelvis is encased. My experience, however, has satisfied me that the amount of surface covered by the bands, as represented in this drawing, is sufficient to keep the muscular contractions under easy and full control until union takes place in the most unpromising cases.

The patient was placed upon a fracture-bed (I do not remember who first contrived it), which was constructed a few hours afterwards in the neighbourhood. I have found this bed a most valuable assistance in the treatment of all severe injuries, and after large operations, for the last twenty years of my practice, and therefore confidently recommend it to all who have similar cases to treat. It consists of a frame three and a half feet wide and six feet long, made of  $1\frac{1}{4}$  or  $1\frac{1}{2}$  inch plank, 4 inches wide, joined by mortise flatwise. Over this, sacking or strong canvas is tightly drawn, and secured by tacks. A hole is made in the centre, of a convenient size for the passage of the alvine evacuations. A sheet is thrown over the bed, with an opening to correspond; pillows are placed upon its upper end, and the bed is fully furnished. This is preferable to any of the complicated and expensive beds in use, because it possesses all the properties required in a

fracture-bed, and yet is so cheap and simple as to place it within the reach of every one, in any locality. It imparts the evenness and firmness of a mattress to the softest bed of down or feathers; the patient can have his evacuations, without the least disturbance of the fracture, by raising the frame and resting it upon stools or chairs; during this time the bed upon which it was placed may be changed and made up, and, if it is desired, the patient may be carried safely from room to room, and, in pleasant weather, out into the open air of a piazza or back yard, upon this fracture-bed.

When the apparatus was applied, and the patient placed upon her bed, she declared herself to be much more comfortable than she had been since the occurrence of the fracture. The tension of the extending and counter-extending bands did not occasion any suffering at the seats of their application, whilst the irritated tissues at the points of fracture, though still painful, were relieved in consequence of the more favourable position of the fractured ends of the bone, as regarded the soft parts. Her constitutional symptoms were those of irritative fever, caused and kept up by local suffering. Her tongue being coated, and her bowels not having been moved for several days, a pill, composed of muriate of morphia gr.  $\frac{1}{4}$ , and calomel grs. v, was ordered to be given at bedtime, and to be followed in the morning by a tablespoonful of castor oil. To the knee, which was inflamed and greatly swollen, fifty leeches were ordered to be applied; after which warm fomentations, to encourage the bleeding, were to be used.

*January 22.* The patient passed a comfortable night. The knee is less swollen and painful, in consequence of the leeching and fomentations, and the calomel and oil had operated twice freely. She relished some gruel for breakfast. The extension and counter-extension were increased by means of the tourniquet, without pain at the seats of their application, and but slightly at the knee and seats of fracture. Fever having abated very considerably, ordered: R.—Quiniæ sulph. ʒj; tinct. ferri muriat. fʒij; syrup, simpl. fʒij. S.—A teaspoonful every two hours during the day, and tinct. opii acet. gtt. xxx at bedtime. Locally, flaxseed-meal poultice to the knee.

From this time forward the case progressed favourably. After a few days the fever subsided entirely, and, under the use of tonics and an improved diet thereafter, her strength gradually improved. Sleep was provided for during the night by the exhibition of the black drop, and oil was given occasionally to remove costiveness. The leeching was repeated once, in consequence of an aggravation of the swelling, from cold contracted one night, when a great and sudden change of the weather had occurred. After the poultices were discontinued, tincture of iodine was applied around the joint, to reduce the remaining tumefaction. At the end of seven weeks the anterior counter-extending strips became loose, and pain and slight abrasion resulted in one night from their pressure and friction, as if loose bandages had been used. These were removed and new ones applied, and all local irritation immediately subsided. When eleven weeks had elapsed, the splints

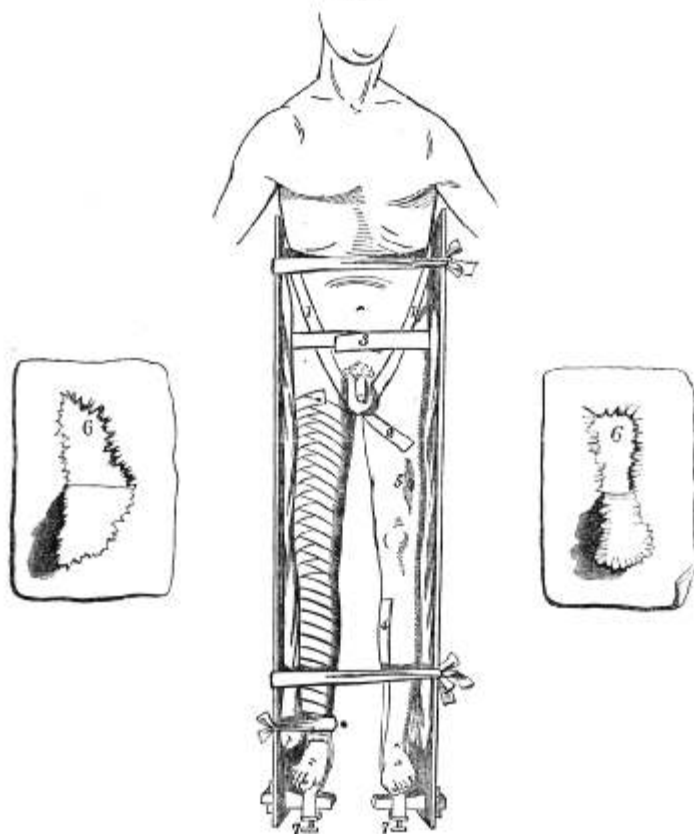
and bandages were all removed for the first time since their application, and the fractures seemed to be united. Enlargement of the knee, without pain, however, was still present. On the following day it was ascertained that the union, especially at the upper seat of fracture, was not sufficiently firm, there being outward deformity and shortening, produced by muscular contraction. The retentive apparatus was again applied, after bringing the femur as nearly as possible into its normal line, and allowed to remain four weeks longer. After this removal, being seventeen weeks from the application of this apparatus, and twenty-four weeks after the occurrence of the fracture, the union was considered sufficiently consolidated, and the apparatus was not again applied. By very careful measurement, at this time, the fractured limb was found to be scarcely one inch shorter than its fellow. In consequence of her protracted confinement, at such an advanced age, she was not able to leave her bed, however, until a week afterwards. Gradually she gained strength, and, by the aid of crutches, became able, at the end of the second week, to move about the room. The union, however, could not have been as perfectly consolidated as was supposed when the final removal of the apparatus took place, since, by a recent measurement, made January 14, the shortening has increased to  $1\frac{1}{2}$  inch. She is, however, fully restored in every other respect, and is able to attend to her ordinary household duties. Notwithstanding the unusual amount of power which it became necessary to apply by the tourniquet, for so protracted a period, no complaint was made of pain at the seats of the application of this power, except when the anterior adhesive counter-extending bands became detached from the surface, and began to act as ordinary loose bands, this being promptly remedied by the application of new strips.

2. The next case is that of Thomas Stokely, aged  $11\frac{1}{2}$  years, whom I attended, as consulting surgeon, at the request of Dr. Theophilus E. Beesley, the family physician. In this there was compound oblique fracture of both thighs, the bones piercing the pantaloons as well as the muscles and integument. Whilst I leave it to Dr. Beesley to present a full account of this case to the College, I furnish the accompanying drawing (Fig. 4, p. 421), which was very accurately taken from life by Kielman. The roller applied to the leg, and many-tailed bandages to the thigh, are shown as applied to the right limb only.

In the treatment of oblique fractures of the bones of the leg, requiring permanent extension and counter-extension, the adhesive plaster bands are quite as valuable as in fracture of the thigh. For simple oblique fracture, two splints, six inches wide, reaching from above the knee to about six inches below the foot, are sufficient (Hutchinson's modified). Each splint should have two holes at its upper and one mortise hole at its lower extremity. Those at the upper extremity are provided for the passage of the counter-extending adhesive bands, and the mortise below is for the reception of a cross-piece upon which the frame of the tourniquet rests. The tour-

niquet in this, as in fracture of the thigh, furnishes the most convenient and efficient extending and counter-extending power. Junk bags, or wadding, to fill up the inequalities of, and give support to, the leg, adhesive plaster

Fig. 4.



1, 1. Anterior adhesive counter-extending strips. 2. Distal extremity of posterior adhesive strip of left side. 3. Adhesive strip surrounding pelvis, binding the anterior and posterior strips to pelvis. 4. Inner extremity of the extending adhesive strip, forming stirrup under the foot to receive the strap of the tourniquet. 5. Cicatrix of left thigh. 6, 6. Holes made in the pantaloons by the protruding fragments of bone, full size. 7, 7. The common tourniquet, by which the power was applied.

bands, about two inches wide, and the roller, or the many-tailed bandage, complete the apparatus. For counter-extension four adhesive plaster bands are necessary, and for extension two are ordinarily sufficient. The former are applied spirally, so as to cross each other, the two anterior just below the tubercle of the tibia, and the two posterior at a point directly opposite. These, in their spiral course upwards, severally cross each other, externally and internally, opposite the joint; their proximate extremities are then passed through the holes in the splint, and securely tied outside. The

latter are applied to the foot and ankle so as to cross each other at the hollow of the foot, then over the tarsus anteriorly, and the upper part of the tendo-Achilles posteriorly. The strap of the tourniquet passes between the sole of the foot and the strips where they cross each other. After the extending and counter-extending adhesive bands are applied, they are bound to the surface by common bandages.

In cases of compound fracture a modification of the common fracture-box may be used very advantageously. In this the foot-board is omitted, and a cross-bar for the reception of the frame of the tourniquet is substituted. The sides of the box each consist of three separate segments. Of these the upper and lower are permanently screwed to the bottom-board, and the central one is attached by hinges. By this arrangement there is full access to the wound, which may be dressed from day to day without disturbing the extension and counter-extension maintained by the permanently attached upper and lower segments. This apparatus was used successfully in the case of Michael Gillis, who had compound comminuted fracture of both bones of the leg, in the winter of 1852-53, and is the sixth of the series of cases published in the *Amer. Journal of the Medical Sciences*, already alluded to. The following drawing represents this apparatus, omitting bandages and side-compresses.

Fig. 5.



1. The four counter-extending adhesive strips, as ~~of~~ encircling the knee and upper part of leg.
2. The two extending adhesive strips crossing at the bottom of the foot, ready to be applied to the foot.
3. Tourniquet.

Dr. BEESLEY then read the following note of the case of compound fracture of both thighs, referred to by Dr. Gilbert:—

In the afternoon of the 27th of 10th mo. (October), 1858, I was called, as the family physician, to Thomas, son of Wm. S. Stokely, No. 58 N. Eighth St., and met Dr. David Gilbert at the bedside of the sufferer. He was a lad of 11½ years of age, who had a compound fracture of both thighs, of the right a little below, and of the left a little above the middle of the femur, occasioned by his falling from a height of about 20 feet directly upon his feet. Subsequent examination of his dress showed that the upper fragment of one thigh, and the lower of the other, had protruded sufficiently to penetrate through his pantaloons in front. My friend Dr. Griscom had first seen the patient, and attended to the reduction of the bones. I assisted Dr. Gilbert in the application of such temporary splints as we had, and of the proper dressings. As a counter-extending band to each thigh,

two strips of adhesive plaster, each an inch and a half wide and two feet long, were so placed as to cross each other at the portion of the thigh where it joins the perineum, extending, the one in front and the other behind, to the upper part of the splint, and were there passed through two holes and were firmly fastened together, an outside splint only being applied to each limb. A broad adhesive strip was applied around the pelvis and over the counter-extending bands, so as to give them additional support. For the extending bands two broad strips of plaster were applied, from a little below the knees, along the legs, sufficiently long to leave a loop below the hollow of each foot for the strap of a tourniquet to pass through. Extension and counter-extension being then made, and the fractures properly adjusted, a common roller-bandage was bound on the adhesive strips from the ankles to the knees, and the many-tailed bandage was applied over the thighs. Between the splints and the thighs cotton wadding, folded in muslin, was used as padding. A compress and cold water dressing were kept to the wounds.

No complaint of pain at the seats of extension and counter-extension was made by our patient. The following day the temporary splints were laid aside, and a narrow board splint for each limb was substituted, extending along the outside from below the arm-pit opposite the nipple to about six inches below the foot. Extension was made and kept up by means of common tourniquets, the frames of which rested on blocks projecting inwardly from the lower extremities of the splints.

The wounds were inspected at the end of the third day, and were found sealed up by coagulated lymph, a slight oozing of bloody serum alone appearing. Dry compresses were now applied, and retained by the bandage of strips, and a flat bottle of ice-water was laid between the thighs, opposite the injured parts, and continued for a fortnight or more, to the apparent comfort of the patient.

After the first day there had been a considerable amount of swelling, which seemed more the result of effusion and congestion than inflammation. The general excitement was at no time great. It was highest about the fourth day, and subsided to a very moderate degree about the close of the first week. Anodynes were given from the commencement, about every four hours, to allay the spasms of pain which occasionally darted through the limbs, and to obtain sleep; they were found useful, in moderate doses, throughout the case. The neutral mixture, with a little tincture of rad. aconite, was administered, whilst there was febrile excitement; also occasionally, when needful, a cooling laxative or an enema. On the complete subsidence of the febrile symptoms, tonics were given, principally sulphate of quinia, with the tincture of the chloride of iron. The patient was placed from the commencement on a fracture-bed, consisting of a simple frame, about 4 inches deep, 5 feet long, and  $2\frac{1}{2}$  feet wide, with strong ticking stretched tightly over it and firmly nailed to it; the ticking was furnished with a hole in the centre for the evacuations, and under this hole was placed

a cushion or pillow. On this fracture-bed he could be lifted, without pain, to attend to his evacuations. The fracture-bed rested on a common mattress, and was supported, when desirable, by stools at the head and foot.

The first complaint he made of pain at the seat of the counter-extending bands was on the morning of the fourteenth day. On examination, it was found that, in order to relieve itching under the plaster, he had separated it for some distance from the skin on the previous evening, and that then this detached portion had acted as an ordinary loose counter-extending band in producing pressure and excoriation; to relieve this, his mother had stuffed cotton under the bands, but still the pain continued. We renewed the loosened portions of the bands, and little complaint was made during the remainder of the treatment until the fourth week, when it became necessary to apply fresh anterior and posterior counter-extending bands. The wound of the left thigh was fully cicatrized on the eighteenth day after the accident; that of the right not until the sixth week. After the first few days the discharge from each wound was very trifling in amount, proceeding only from the granulating surfaces.

We had reason to believe that firm union had taken place at the end of the fifth week; but, at the urgent request of the father of the patient, the splints were continued until the middle of the seventh week, or the forty-sixth day from the accident, when all retentive apparatus was removed. The thighs have their natural form and length. The patient was free, during the entire period of treatment, from the usual suffering experienced at the seats of extension and counter-extension; the only exception to this was the very slight uneasiness above mentioned, induced by the patient's interference with the bands at and near the perineum. The strips of adhesive plaster, by which extension was made, remained without removal from the day they were applied to the end of the treatment.

In writing an account of this interesting case, I have drawn freely from the notes of it kept by Dr. Gilbert, to whose skill, under Providence, I attribute its completely successful result, the more remarkable from the age, nervous constitution, and active character of the lad. Of all the cases of fracture of the thigh which have come under my notice in the course of a pretty extensive practice of more than forty years, there has been none where the apparatus made use of was so simple, so painless, and yet so thoroughly efficient in retaining the injured limbs in their natural position. The fracture-bed, by its cheapness, lightness, and convenience for moving the patient without pain and allowing the necessary evacuations of the bowels, seemed almost all that was to be desired in such a case. At first there was some difficulty in urinating, and the catheter was used a few times; after that, however, a large-mouthed flattish phial was placed so as to receive the urine, when the patient desired to void it. In conclusion I may add, that now, at the end of three months from the accident, the boy walks with facility and without limping, there only appearing some stiffness in his knees.